AUG 0 6 1988

FEM 1.209:120172

86 594-C-9

FLOOD INSURANCE STUDY

CITY OF FERNANDINA BEACH, FLORIDA

NASSAU COUNTY

BEST COPY AVAILABLE

COMPLETED

SEPTEMBER 30, 1988

ORIGINAL

Federal Emergency Management Agency

COMMUNITY NUMBER - 120172

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original Flood Insurance Study. These revisions are presented in Section 7.0.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Background and Purpose	1
2.0	INVESTIGATIONS	1
	2.1 Previous Studies	1
	2.2 Data Collection and Review	2
	2.3 Wave Height Analysis	2
	2.4 Results	3
3.0	FLOODPLAIN MANAGEMENT APPLICATIONS	6
	3.1 Flood Boundaries	6
	3.2 Base Flood Elevation	6
	3.3 Velocity Zones	7
4.0	INSURANCE APPLICATION	7
	4.1 Flood Hazard Factors	7
	4.2 Flood Insurance Zones	8
	4.3 Flood Insurance Rate Maps	8
5.0	OTHER STUDIES	10
6.0	REFERENCES	10
7.0	REVISIONS DESCRIPTION	11
	7.1 First Revision (Revised October 28, 1987)	11
	a. Acknowledgements	11
	b. Scope	11
	c. Hydrologic and Hydraulic Analyses	11
	d. Insurance Application	12
	e. Other Studies	12

00
11

TABLE OF CONTENTS (cont.)

		Page
f.	Location of Data	12
g.	References and Bibliography	13

FIGURES

Figure	1	-	Transect Location Map	4
Figure	2	-	Hypothetical Transect Schematic	5

TABLE

Table	1	-	Coastal Flood Insurance Zone Data	9

EXHIBITS

Flood Insurance Rate Map Index

Flood Insurance Rate Maps

1.0 INTRODUCTION

1.1 Background and Purpose

The Federal Emergency Management Agency recently adopted recommendations by the National Academy of Sciences to include prediction of wave heights in flood insurance studies for coastal communities subject to storm surge flooding, and to report the estimated wave crest elevations as the base flood elevations on Flood Insurance Rate Maps (FIRMs).

Previously, FIRMs were produced showing only the stillwater storm surge elevations due to the lack of a suitable and generally applicable methodology for estimating the wave crest elevations associated with storm surges. These stillwater elevations were subsequently stipulated in community flood plain management ordinances as the minimum elevation of the lowest floor, including basement, of new construction. Communities and individuals had to consider the additional hazards of velocity waters and wave action on an ad hoc basis. Because there has been a pronounced tendency for buildings to be constructed only to meet minimum standards, without consideration of the additional hazard due to wave height, increasing numbers of people could unknowingly be accepting a high degree of flood-related personal and property risk in coastal areas subject to wave action. Therefore, the Federal Emergency Management Agency has pursued the development of a suitable methodology for estimating the wave crest elevations associated with storm surges. The recent development of such a methodology by the National Academy of Sciences (Reference 1) has led to the adoption of wave crest elevations for use as the base flood elevations in coastal communities.

Several major hurricanes have affected the Florida coast in the past. One which had devastating effects on the Fernandina Beach area occurred on September 9, 1964. The storm surge caused extensive beach erosion from Daytona Beach to the Georgia border, inundated many coastal communities, washed out beach roads and swept several residences into the sea. A surge of 12 feet Mean Sea Level (MSL) and winds of 100 knots were reported near St. Augustine, Florida. The damage in Florida was estimated at 200-300 million dollars (Reference 2).

The purpose of this study is to revise the FIRM for the City of Fernandina Beach to include the effects of wave action from the Atlantic Ocean.

2.0 INVESTIGATIONS

2.1 Previous Studies

Stillwater elevations used in the previous FIRM for Fernandina Beach were determined by the National Oceanic and Atmospheric Administration (NOAA) (Reference 2). These elevations were determined using the Joint Probability Method which involves such factors as central pressure, radius to maximum winds, directional approach to coast and forward speed, along with the hydrodynamic model SPLASH. The stillwater elevations used in this analysis were developed by Camp Dresser McKee, Inc. for the Federal Emergency Management Agency using the hydrodynamic model TTSURGE.

The elevations developed by Camp Dresser McKee compared favorably with those developed by NOAA. This study supersedes the previous FIRM.

2.2 Data Collection and Review

All available source data applicable for the wave height analysis were collected and reviewed. Because wave height calculations are based on such parameters as the size and density of vegetation, natural barriers (sand dunes), buildings, and other manmade structures, it was necessary to obtain detailed information on the physical and cultural features of the study area.

The following agencies were contacted regarding information for this wave height analysis: Florida Department of Transportation, Florida Department of Natural Resources, U.S. Army Corps of Engineers, Jacksonville District; National Oceanic and Atmospheric Administration, U.S. Department of Interior, Fish and Wildlife Service; and the City of Fernandina Beach.

The principal source materials used for the wave heights analysis are described below.

1. Aerial photographs (stereoscopic coverage) of the Florida coast (Reference 3) were used to determine the size, location and density of vegetation and other physical features.

2. Topographic maps at a scale of 1" = 100' with 2 foot contour intervals (Reference 4) were used along the Atlantic Coast.

3. U.S. Geological Survey topographic maps at a scale of 1:24,000 with contour intervals of 5 feet (Reference 5) were used as work maps.

4. U.S. Department of Interior, Fish and Wildlife Service Biological Services Program's Deltaic Plain Region Habitat Maps (Reference 6) were used to identify vegetation indigenous to the study area.

2.3 Wave Height Analysis

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the National Academy of Sciences report (Reference 1). This method is based on the following major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest elevation is 70 percent of the total wave height plus the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in Reference 1. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Wave heights were computed along transects (cross section lines) that were located along the coastal areas, as illustrated in Figure 1, in accordance with the Users Manual for Wave Height Analysis (Reference 7). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

The transects were continued inland until the wave was dissipated or until flooding from another source with equal or greater elevation was reached. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation for the 100-year flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. Areas with a wave component 3-feet or greater were designated as velocity zones. Other areas subject to wave action were designated as A Zones with base flood elevations adjusted to include wave crest elevations.

For purposes of this analysis, it was assumed that the dunes along the Atlantic Ocean would remain intact during a storm event and would be effective in decreasing wave heights.

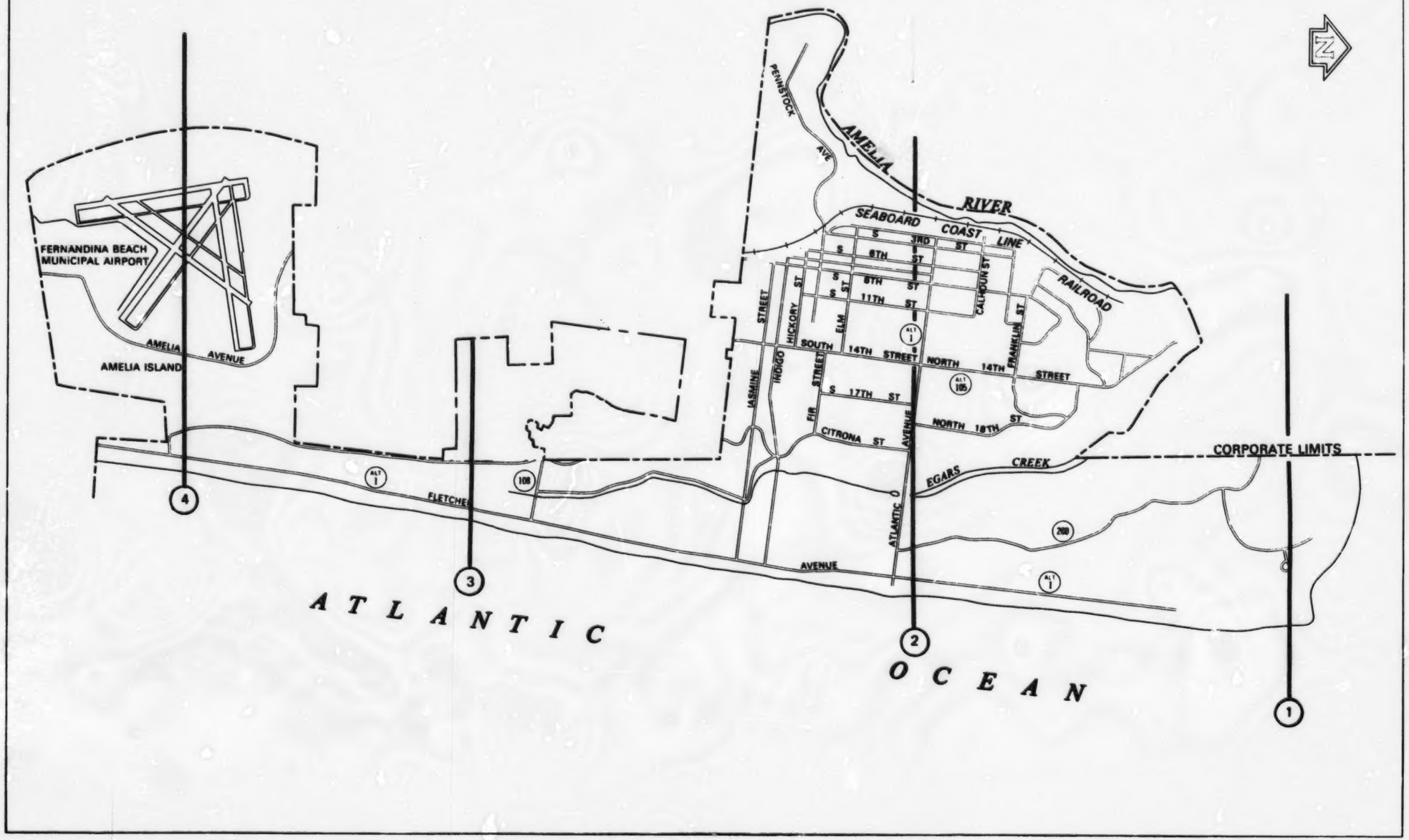
Figure 2 is a profile for a hypothetical transect showing the effects of energy dissipation on a wave as it moves inland. This figure shows the wave elevations being diminished by obstructions, such as buildings, vegetation, and rising ground elevations and being increased by open, unobstructed wind fetches. Actual wave conditions in the City of Fernandina Beach may not necessarily include all the situations illustrated in Figure 2.

After analyzing wave heights along each transect, wave elevations were interpolated between transects. Various source data were used in the interpolation, including the topographic work maps, aerial photographs, and engineering judgement. Controlling features affecting the elevations were identified and considered in relation to their positions at a particular transect and their variation between transects. Computed wave elevations are based upon existing topography, vegetation and current development patterns and will require recomputation if significant changes occur in any of the above factors.

2.4 Results

Computed wave heights and elevations associated with the 100-year storm surge are summarized below for various reaches in the study areas.

TRANSECT LOCATION MAP



FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF FERNANDINA BEACH, FL

(NASSAU CO.)

FIGURE 1

BEST COPY AVAILABLE

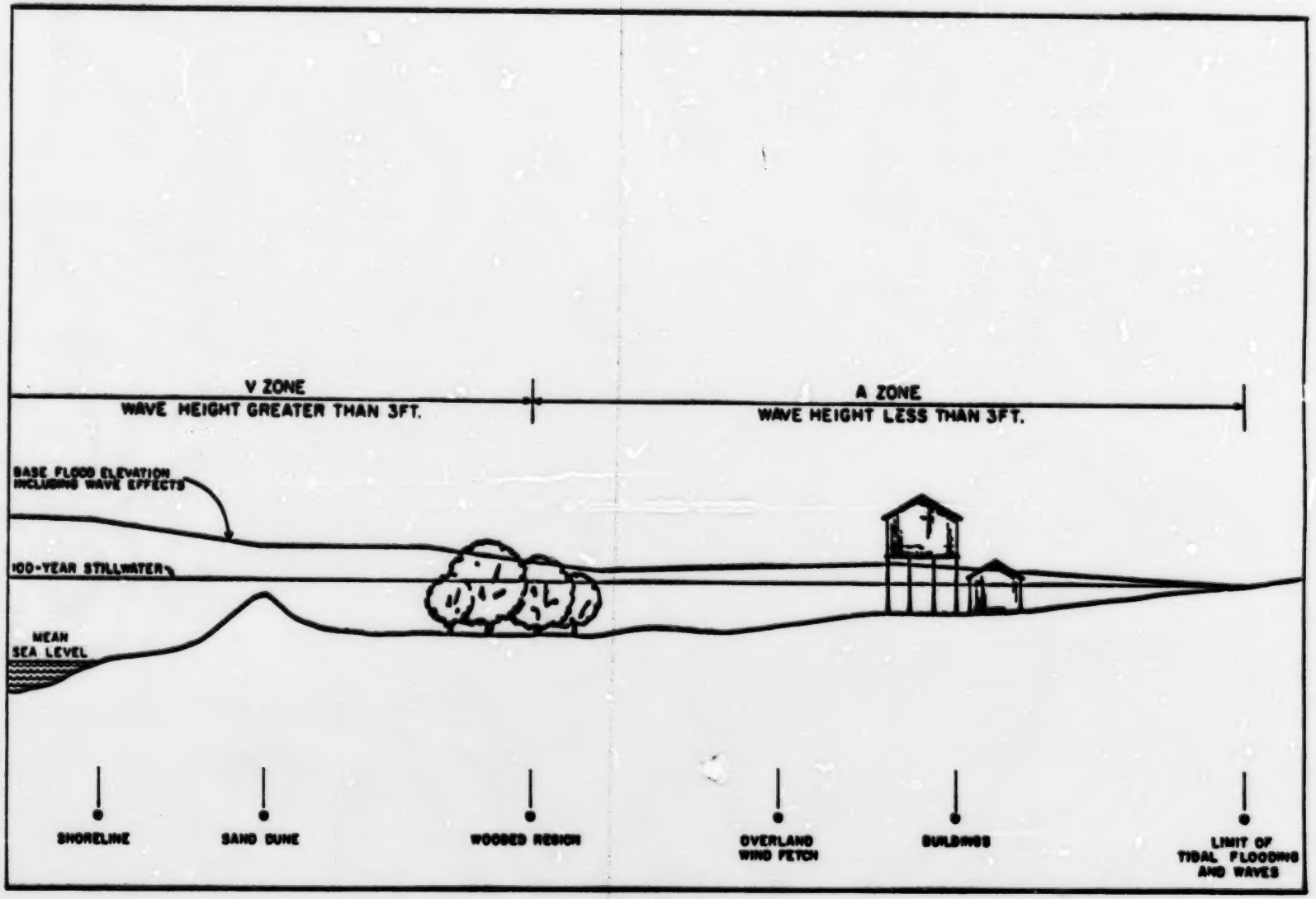


FIGURE 2
HYPOTHETICAL TRANSECT SCHEMATIC

BEST COPY AVAILABLE

5

Transects 1-4

These transects represent the area along the Atlantic Ocean and extend to the backside of the island. Inland from the coast the ground rises sharply to elevation 15 feet NGVD. The accompanying decrease in water depth reduces the wave component to less than three feet within 500 feet of the coast and a 3-foot wave is regenerated on the back side of the island. The maximum wave crest elevation is 16 feet in the northern part of the city and 15 feet in the southern part. On the backside of the island a maximum wave crest elevation of 13 feet NGVD is generated.

3.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage local governments to adopt sound flood plain management programs designed to reduce future flood losses. The FIRM for Fernandina Beach has been revised to incorporate the latest available information, including wave height data, to assist the community in developing the most appropriate and effective flood plain management measures.

3.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for purposes of flood plain management. This flood has a 1 percent chance of being equalled or exceeded each year and is expected to be exceeded once on the average during any 100-year period. The risk of having a flood of this magnitude or greater increases when periods longer than 1 year are considered. For example, over a 30-year period, there is a 26 percent chance of experiencing a flood equal to or greater than the 100-year flood. The 500-year flood plain is also shown on the FIRM to indicate areas of moderate flood hazards.

Areas inundated by the 100-year flood are shown as A and V Zones on the community's FIRM. It is in these areas that the Federal Emergency Management Agency requires local communities to exercise flood plain management measures as a condition for participation in the National Flood Insurance Program.

3.2 Base Flood Elevation

Areas within the community studied by detailed engineering methods have base flood elevations established in A and V Zones. These are the elevations of the base (100-year) flood relative to the National Geodetic Vertical Datum (Mean Sea Level of 1929). In coastal areas affected by wave action, base flood elevations are generally maximum at the normal open shoreline. These elevations generally decrease in a landward direction at a rate dependent on the presence of obstructions capable of dissipating the wave energy. Where possible, changes in base flood elevations have been shown in 1-foot increments on the FIRM. However, where the scale did not permit, 2- or 3-foot increments were sometimes used. Base flood elevations shown in the wave action areas represent the average elevation within the zone. Current program regulations generally require that all new construction be elevated such that the first floor, including basement, is above the base flood elevation in A and V Zones.

BEST COPY AVAILABLE

3.3 Velocity Zones

The U.S. Army Corps of Engineers (Reference 8) has established the 3-foot wave as the criterion for identifying coastal high hazard zones. This was based on a study of wave action effects on structures. This criterion has been adopted by the Federal Emergency Management Agency for the determination of V Zones. Because of the additional hazards associated with high-energy waves, the National Flood Insurance Program regulations require much more stringent flood plain management measures in these areas, such as elevating structures on piles or piers. In addition, insurance rates in V Zones are higher than those in A Zones with similar numerical designations.

The location of the V Zone is determined by the 3-foot wave as discussed previously. The detailed analysis of wave heights performed in this study allowed a much more accurate location of the V Zone to be established. The V Zone generally extends inland to the point where the 100-year flood depth is insufficient to support a 3-foot breaking wave.

4.0 INSURANCE APPLICATION

The assignment of proper actuarial insurance rates requires that frequency and depth of flooding be estimated as accurately as possible. Because waves can add considerably to expected flood depths, it is important that insurance rates consider this additional hazard. The Federal Emergency Management Agency has developed a process to transform the data from this study into flood insurance criteria. This process includes the determination of Flood Hazard Factors and the designation of flood insurance zones.

4.1 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables.

The FHF is shown as a three-digit code that expresses the difference between the 10- and 100-year flood elevations to the nearest 0.5 foot. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, the FHF is computed to the nearest foot.

In coastal areas subject to wave action (wave heights greater than 3 feet), the FHF is determined using the difference between the 10-year and 100-year wave crest elevations. This difference is estimated as the difference between the 10- and 100-year stillwater elevations multiplied by 1.55. For areas where wave heights are less than three feet, the FHF is determined using the difference between the 10-year stillwater elevation and the 100-year wave crestelevation. For areas protected from wave action, the FHF is determined using the difference between the 10-year and 100-year stillwater elevations.

4.2 Flood Insurance Zones

After wave elevations for the 100-year storm surge were determined and mapped, the study areas were divided into zones, each having a specific flood potential and Flood Hazard Factor. Each zone was assigned one of the following flood insurance zone designations:

Zones V12, V13, and V14:	Special Flood Hazard Areas inundated by the 100-year flood, that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zones A11:	Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations determined and zone designations assigned according to the Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood plain, including areas that are protected from the 100-year and 500-year floods by dike, levee, or other water control structure; and areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot, or where the contributing drainage area is less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas not subject to flooding by the 500-year flood. Zone C is not subdivided.

Table 1, "Coastal Flood Insurance Zone Data," provides a listing of transects, FHFs, flood insurance zones, and base flood elevations for each flooding source in the study area.

4.3 Flood Insurance Rate Maps

After flood insurance zones were established for the study area, the Flood Insurance Rate Map (FIRM) for the City of Fernandina Beach, was revised to incorporate the new zone information. These maps contain the official delineation of flood insurance zones and base flood elevations.

BEST COPY AVAILABLE

FLOODING SOURCE	TRANSECTS	PANELS	STILLWATER ELEVATIONS				FLOOD HAZARD FACTOR[1]	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
			10-YR	50-YR	100-YR	500-YR			
Atlantic Ocean	1	0001,0002, 0004	6.1	9.5	10.3	13.0	065 055	V13 A11[3]	13-16 10-12
	2	0001,0004, 0005	6.1	9.5	10.3	13.0	065 055	V13 A11[3]	13-16 10-12
			6.1	9.9	10.8	13.4	070 055	V14 A11[3]	13 11-12
	3	0003,0004, 0005,0006, 0007	5.9	(2)	9.9	(2)	060 055	V12 A11[3]	13-15 10-12
			6.2	10.1	10.9	13.5	070 055	V14 A11[3]	13 11-12
	4	0009	5.8	9.3	9.6	12.4	060 055	V12 A11[3]	13-15 10-11
		0009	5.9	10.0	10.0	13.0	055	A11[3]	11

1-Includes the effects of Wave Action, where applicable.

2-Due to map scale limitations, Base Flood Elevations (BFEs) shown on the Flood Insurance Rate Map may represent average elevation for the zone depicted.

3-Average weighted value.

TABLE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF FERNANDINA BEACH, FL

(NASSAU CO.)

COASTAL FLOOD INSURANCE ZONE DATA

ATLANTIC OCEAN

5.0 OTHER STUDIES

A Flood Insurance Rate Map for Nassau County, Florida is being prepared and will include wave height analysis. The study for Nassau County will be in agreement with this study.

6.0 REFERENCES

1. National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated With Storm Surges, 1977.

2. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Fernandina Beach, Nassau County, Florida, July 1976.

3. State of Florida Department of Transportation, Aerial Photographs of Nassau County, Florida, Scale 1:12,000, March 1980.

4. State of Florida, Department of Natural Resources, Coastal Construction Control Line - Nassau County, Florida, Scale 1:12,000, with 2 feet contour intervals, November 1979.

5. U.S. Geological Survey Quadrangle Maps, 7.5-Minute Series Topographic Maps; Scale 1:24,000 with 5 feet contour intervals: Fernandina Beach, Florida, 1958 (Photorevised 1970), Amelia City, Florida 1958 (Photorevised 1970).

6. U.S. Department of Interior, Bureau of Land Management, Fish and Wildlife Service, National Wetlands Inventory Map, Scale 1:24,000: Fernandina Beach, Florida and Amelia City, Florida, November 1972.

7. Federal Emergency Management Agency, Users Manual for Wave Height Analysis, Revised February 1981.

8. U.S. Army Corps of Engineers, Galveston District, Guidelines for Identifying Coastal High Hazard Zones, June 1975.

7.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood hazard data located at the Nassau County Courthouse, Fernandina Beach, Florida.

7.1 First Revision (Revised October 28, 1987)

a. Acknowledgments

The hydrologic and hydraulic analyses for this Revisions Description were performed by the Federal Emergency Management Agency (FEMA). The work was completed in May 1987.

b. Scope

The Flood Insurance Study for the City of Fernandina Beach, Nassau County, Florida, was revised to include 100-year stillwater elevation adjustments affecting the surge analysis for the three-county area of Glynn and Camden Counties, Georgia, and Nassau County, Florida, and to include marsh grass methodology.

c. Hydrologic and Hydraulic Analyses

The hydrologic analysis for the City of Fernandina Beach was modified to reflect a reevaluation of local storm statistics and new hydrodynamic methodology. The statistical approach was based on new meteorological data developed by the National Weather Service (Reference 9). These data were used to establish adjustments to the hurricane parameter statistics. The adjusted parameter statistics include storm frequency, pressure deficit distribution, and radius to maximum wind-pressure deficit correlation. The hydrodynamic adjustments inland of the open coast reflect new methodologies used in the 1986 version of the SURGE program (Reference 10). The adjustments include better resolution of bathymetry and the incorporation of a moving boundary.

The statistical and hydrodynamical adjustments were combined to obtain revised 100-year stillwater elevations. The adjusted stillwater elevations decreased zero to three feet from the stillwater elevations shown in Table 1, Coastal Flood Insurance Zone Data.

The wave height analysis for the county incorporated the adjusted 100-year stillwater elevations and marsh grass methodology, which was added to the WHAFIS program in May 1985.

The original transects were modified so that marshy areas were treated as marsh rather than inland fetches with adjusted ground elevations.

d. Insurance Application

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

e. Other Studies

The Flood Insurance Study published for Nassau County, Florida (Reference 11) is in agreement with this study.

Revisions to the Flood Insurance Study published for Camden County, Georgia, are in progress (References 12) and are in agreement with this study.

This Flood Insurance Study supersedes the previously published Flood Insurance Study for the City of Fernandina Beach, Florida (Reference 13).

f. Location of Data

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

g. References and Bibliography

9. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Office of Hydrology, Water Management Information Division, Hurricane Climatology for the Atlantic and Gulf Coasts of the United States, December 1986.

10. Federal Insurance Administration, Coastal Flooding Hurricane Storm Surge Model, revised 1987.

11. Federal Emergency Management Agency, Flood Insurance Study, Nassau County, Unincorporated Areas, Florida, May 1988.

12. ----------, Flood Insurance Study, Camden County, Unincorporated Areas, Georgia, June 1984, revision in progress.

13. ————, Flood Insurance Study, City of Fernandina Beach, Nassau County, Florida, April 1983.

☆U.S. GOVERNMENT PRINTING OFFICE: 1988 - 201-724/80175